

WHAT IS CLAIMED IS:

1. A method for encoding information symbols with a differential space-time block code (STBC) and transmitting the encoded information symbols via a plurality of transmission antennas for transmit diversity in a wireless communication system, the method comprising the steps of:

receiving a block of information symbols;

generating normalized symbols by multiplying the information symbols by a block of previously transmitted transmission symbols and then dividing the multiplication result by a normalization value that is determined as a size of the previously transmitted transmission symbols;

forming the normalized symbols into a plurality of combinations to transmit the normalized symbols once at each antenna for each time period; and

transmitting the combinations via the transmission antennas for a plurality of corresponding symbol durations.

2. The method of claim 1, wherein the normalized symbols are generated in accordance with

$$S_{v+1} = \sum_{k=1}^K P_{v+1,k} \frac{V_k(S_v)}{|S_v|}$$

where S_{v+1} is a symbol block transmitted for a $(v+1)^{\text{th}}$ block duration, S_v is a symbol block transmitted for a v^{th} block duration, $P_{v+1,k}$ is a k^{th} information symbol transmitted for a $(v+1)^{\text{th}}$ block duration, K is a number of the information symbols, and $V_k(S_v)$ is a k^{th} symbol combination transmitted in a symbol block S_v .

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3. The method of claim 1, wherein the normalization value is determined in accordance with

$$|S_v| = \sqrt{|S_{v,1}|^2 + |S_{v,2}|^2 + \dots + |S_{v,M}|^2}$$

where $|S_v|$ is the previous normalization value, and S_{v,N_t} is a symbol transmitted for a previous block duration from a N_t -th transmit antenna.

5 4. The method of claim 1, wherein the information symbols are real numbers, and are grouped by a predetermined number of symbols to transmit one of PSK (Phase Shift Keying) and QAM (Quadrature Amplitude Modulation) data.

5. A method for receiving information symbols encoded with a differential space-time block code (STBC) before being transmitted and decoding the received information symbols in a wireless communication system, the method comprising the steps of:

collecting a signal received at a reception antenna from a plurality of transmission antennas for a block duration;

15 calculating a substitution signal by multiplying the received signal by a signal received for a previous block duration;

estimating channel power for a channel from the plurality of transmission antennas to the reception antenna;

normalizing the estimated channel power with a normalization value that is determined as a size of previously received symbols; and

20 calculating information symbols by dividing the substitution signal by the normalized channel power.

6. The method of claim 5, wherein the information symbols are calculated by

$$P_{v+1,n} = \frac{R\{R_{v+1}^n R_v^{nH}\} - R\{W_n\}}{\hat{P}_B |S_v|}$$

where $P_{v+1,n}$ is an n^{th} information symbol at a current block duration $v+1$, $R\{\cdot\}$ indicates real conversion, R_{v-1}^n and R_v^n are reception signal combinations

created to calculate an n^{th} symbol with signals received for a current block duration $v+1$ and a previous block duration v , respectively, $(\cdot)^H$ indicates Hermitian transpose, W_n is a noise at an n^{th} symbol duration, \hat{p}_B is the estimated channel power, and $|S_v|$ is the normalization value.

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7. The method of claim 5, wherein the estimated channel power is calculated by

$$\hat{p}_B = E \{ r_{v+1,i}^* r_{v+1,i} \} - \sigma_w^2$$

where $r_{v+1,i}$ indicates a signal received for an i^{th} symbol duration in a
10 $(v+1)^{\text{th}}$ block duration, and σ_w^2 indicates a noise variance.

8. The method of claim 5, wherein the estimated channel power is calculated by

$$\hat{p}_B = \frac{1}{L} \sum_{j=1}^L \sum_{i=1}^4 r_{v+j-\frac{L}{2},i}^* r_{v+j-\frac{L}{2},i}$$

15 where $r_{v+1,i}$ indicates a signal received for an i^{th} symbol duration in a $(v+1)^{\text{th}}$ block duration, σ_w^2 indicates a noise variance, and L is a length of symbol durations used for the estimation of channel power.

9. The method of claim 5, wherein the normalization value is
20 calculated by

$$|S_v| = \sqrt{|S_{v,1}|^2 + |S_{v,2}|^2 + \dots + |S_{v,M}|^2}$$

$$|S_v| = \sqrt{|s_{v,1}|^2 + |s_{v,2}|^2 + |s_{v,3}|^2 + |s_{v,4}|^2}$$

where $|S_v|$ is a normalization value determined as a size of symbols received for a previous duration $v+1$, and S_{v,N_t} is a symbol received for a previous
25 block duration from a N_t -th transmit antenna.

10. The method of claim 5, wherein the normalization value is

calculated by dividing an autocorrelation value of a previously received signal by the estimated channel power and then taking a square root.

11. The method of claim 10, wherein the normalization value is
5 calculated by

$$|s_v| = \sqrt{\frac{R\{R_v^n R_v^{nH}\} - R\{W_n\}}{\hat{P}_B}}$$

where $|S_v|$ is the normalization value, S_v is a symbol block received at a previous duration v , $R\{\cdot\}$ indicates real conversion, R_v^n is reception signal combinations created to calculate an n^{th} information symbol with a signal
10 received at a previous duration v , $(\cdot)^H$ indicates Hermitian transpose, W_n is a noise at an n^{th} symbol duration, and \hat{P}_B is the estimated channel power.

12. The method of claim 5, wherein the information symbols are real numbers and are grouped by a predetermined number of symbols to carry one of
15 PSK (Phase Shift Keying) and QAM (Quadrature Amplitude Modulation) data.

13. A transmitter for encoding information symbols with a differential space-time block code (STBC) and transmitting the encoded information symbols via a plurality of transmission antennas for transmit
20 diversity in a wireless communication system, the transmitter comprising:

a delay group for delaying a block of previously transmitted transmission symbols;

a serial-to-parallel converter for collecting the previous transmission symbols and parallel-converting the collected previous transmission symbols;

25 a multiplier group for multiplying the parallel-converted previous transmission symbols by information symbols;

a normalizer for outputting normalized symbols by dividing outputs of the multiplier group by a normalization value that is determined as a size of the

previously transmitted transmission symbols; and

an encoder for forming the normalized symbols into a plurality of combinations to transmit the normalized symbols once at each antenna for each time period via the transmission antennas for a plurality of corresponding symbols durations.

14. The transmitter of claim 13, wherein the normalized symbols are generated in accordance with

$$S_{v+1} = \sum_{k=1}^K P_{v+1,k} \frac{V_k(S_v)}{|S_v|}$$

10 where S_{v+1} is a symbol block transmitted for a $(v+1)^{\text{th}}$ block duration, S_v is a symbol block transmitted for a v^{th} block duration, $P_{v+1,k}$ is a k^{th} information symbol transmitted for a $(v+1)^{\text{th}}$ block duration, K is the number of the information symbols, and $V_k(S_v)$ is a k^{th} symbol combination transmitted in a symbol block S_v .

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15. The transmitter of claim 13, wherein the normalization value is determined in accordance with

$$|S_v| = \sqrt{|S_{v,1}|^2 + |S_{v,2}|^2 + \dots + |S_{v,M}|^2}$$

where $|S_v|$ is the previous normalization value, and S_v is a symbol
20 transmitted for a previous block duration from a N_t -th transmit antenna.

16. The transmitter of claim 13, wherein the information symbols are real numbers, and are grouped by a predetermined number of symbols to transmit one of PSK (Phase Shift Keying) and QAM (Quadrature Amplitude Modulation)
25 data.

17. A receiver for receiving information symbols encoded with a differential space-time block code (STBC) before being transmitted and decoding

the received information symbols in a wireless communication system, the receiver comprising:

- a delay group for delaying a signal received for a previous block duration;
- 5 a symbol collector for collecting a signal received from a plurality of transmission antennas for a block duration;
- a multiplier group for outputting a substitution signal by multiplying the received signal by the previously received signal;
- a power estimator for estimating channel power for a channel from the plurality of transmission antennas to the receiver, with the received signal;
- 10 a normalizer for outputting normalized channel power by multiplying the estimated channel power by a normalization value that is determined as a size of the previously received symbols;
- a divider for calculating information symbols by dividing the substitution
- 15 signal by the normalized channel power; and
- a detector for restoring an information sequence with the information symbols.

18. The receiver of claim 17, wherein the information symbols are
- 20 calculated by

$$P_{v+1,n} = \frac{R\{R_{v+1}^n R_v^{nH}\} - R\{W_n\}}{\hat{P}_B |S_v|}$$

- where $P_{v+1,n}$ is an n^{th} information symbol at a current block duration $v+1$, $R\{\cdot\}$ indicates real conversion, R_{v+1}^n and R_v^n are reception signal combinations created to calculate an n^{th} symbol with signals received for a current block
- 25 duration $v+1$ and a previous block duration v , respectively, $(\cdot)^H$ indicates Hermitian transpose, W_n is a noise at an n^{th} symbol duration, \hat{P}_B is the estimated channel power, and $|S_v|$ is the normalization value.

19. The receiver of claim 17, wherein the estimated channel power is calculated by

$$\hat{p}_B = E \{ r_{v+1,i}^* r_{v+1,i} \} - \sigma_w^2$$

where $r_{v+1,i}$ indicates a signal received for an i^{th} symbol duration in a
5 $(v+1)^{\text{th}}$ block duration, and σ_w^2 indicates a noise variance.

20. The receiver of claim 17, wherein the estimated channel power is calculated by

$$\hat{p}_B = \frac{1}{L} \sum_{j=1}^L \sum_{i=1}^4 r_{v+j-\frac{L}{2},i}^* r_{v+j-\frac{L}{2},i}$$

10 where $r_{v+1,i}$ indicates a signal received for an i^{th} symbol duration in a $(v+1)^{\text{th}}$ block duration, σ_w^2 indicates a noise variance, and L is a length of symbol durations used for the estimation of channel power.

21. The receiver of claim 17, wherein the normalization value is
15 calculated by

$$|S_v| = \sqrt{|S_{v,1}|^2 + |S_{v,2}|^2 + \dots + |S_{v,N_t}|^2}$$

where $|S_v|$ is a normalization value determined as a size of symbols received for a previous duration $v+1$, and S_v is a symbol received for a previous block duration from a N_t -th transmit antenna.

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22. The receiver of claim 17, wherein the normalization value is calculated by dividing an autocorrelation value of a previously received signal by the estimated channel power and then taking a square root.

25 23. The receiver of claim 22, wherein the normalization value is calculated by

$$|s_v| = \sqrt{\frac{R\{R_v^n R_v^{nH}\} - R\{W_n\}}{\hat{P}_B}}$$

where $|S_v|$ is the normalization value, S_v is a symbol block received at a previous duration v , $R\{\cdot\}$ indicates real conversion, R_v^n is reception signal combinations created to calculate an n^{th} information symbol with a signal
 5 received at a previous duration v , $(\cdot)^H$ indicates Hermitian transpose, W_n is a noise at an n^{th} symbol duration, and \hat{P}_B is the estimated channel power.

24. The receiver of claim 18, wherein the information symbols are real numbers and are grouped by a predetermined number of symbols to carry
 10 one of PSK (Phase Shift Keying) and QAM (Quadrature Amplitude Modulation) data.